DOCUMENT RESUME

ED 209 167 SO 013 731

AUTHOR Maruyama, Magoroh
TITLE Environmentalism in the Future: Reducing its Dogmatism and Pseudo-Scientism.
PUB DATE Aug 81
NOTE 22p.; Paper presented at the Annual Meeting of the American Sociological Association (Toronto, Ontario, Canada, August, 1981).

EDRS PRICE MF01/PC01 Plus Postage.
DESCRIPTORS *Dogmatism; Environmental Education; *Environmental Standards; *Futures (of Society); Pollution
IDENTIFIERS *Environmental Protection; Fallacies; *Pseudoscience

ABSTRACT

This paper examines fallacious assumptions from which the environmentalist movement of the future must free itself. The first is the fallacy of zero sum game assumption, believing that in order to protect the environment, industry must be decreased. We are beginning to see some clever, positive sum use of industry in relation to the environment. For example, the cooling system of some electric power generating facilities in Southern Illinois discharge heated water into lakes. This was previously called "thermal pollution." However, now the heated lakes are used for fish farming. The second fallacy discussed is that of standardized regulation, believing that it is scientific to formulate and impose the same regulations in all situations regardless of the context. We must have environmental regulations, but these regulations must not be applied blindly. We need to establish requirements that the environmental regulations should be contextual. For example, the requirement to have sewage connected toilets may be environmental in some areas, but not in areas where the overloaded sewage system discharges untreated sewage into a river, such as in the eastern suburbs of Portland, Oregon. The third fallacy examined is that of equilibrium as natural and desirable. Believing that nature must be made to remain unchanged is unscientific and dogmatic. Nature keeps changing and evolving, even without humans. These three fallacies work against the environment. They aggravate the goal moratorium syndrome of today resulting from the mutual amplification of goallessness between consumer, business, and government. (Author/RM)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED209167

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)

X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

"PERMISSION TO REPRODUCE THIS MATERIAL HAS BEEN GRANTED BY

Magoroh Maruyama

TO THE EDUCATIONAL RESOURCES INFORMATION CENTER (ERIC)."

Environmentalism in the Future:

Reducing its Dogmatism and Pseudo-scientism

by

Magoroh Maruyama

SO 013 731

Environmentalism in the Future: Reducing its Dogmatism and Pseudo-scientism

DEC 7 1981

by Magoroh Maruyama

Since the early 1960's we have seen a series of social and philosophical movements: counter-culture movements, ethnic movements, ecology movements, and various liberation movements. However, it has become increasingly clear that many of the proponents of these movements have fallen into the same fallacies as those of the old logic, against which they rebelled. For example, the do-your-own-thingism and the small-is-beautiful movement are often distorted into isolationism and regionalism instead of heterogenistic interactive symbiosis; the ecology movement into static harmonism instead of the pattern-generating harmonism of natural systems; the "consciousness" movement into the dichotomy of the mental and the physical and into hierarchical rank-ordering of values; new mushrooming religions into universalistic homogenism; holism into abstractionism instead of relational study of specific contexts. These instances indicate the unwitting persistence of the fallacies of the old logic even among the avant-garde revolutionaries. Even in those instances in which the initiator of the movement is free from the fallacies of the traditional logic, there are inevitably many enthusiastic but shallow advocates and followers.

Much of the environmentalist movement shares the same drawbacks. Specifically, many of its advocates are afflicted with the following fallacies: (1) Fallacy of zero-sum game assumption, believing that in order to protect the environment, industry must be decreased; (2) Fallacy of standardized regulation, believing that it is scientific to formulate and impose the same regulations in all situations regardless of the context; (3) Fallacy of equilibrium as natural and desirable, believing that the nature

tends to and must be made to remain unchanged.

Actions based on these fallacies do not protect the environment. They work against the environment. They also hinder the nature/people symbiosis. And as we discuss in this paper, they aggravate the goal moratorium syndrome of today, resulting from the mutual amplification of goallessness between consumers, business and government.

The environmentalist movement, if based on these fallacies, amounts to a dogmatism and a pseudo-scientism. The purpose of this paper is to contribute to removal of these fallacies and to the improvement of mutually beneficial relations between environemnt, people, business and government.

1. The fallacy of zero-sum game assumption:

One of the very basic assumptions in the American culture is that a person's gain is someone else's loss. However, one of the basic principles of biological, ecological and social processes is formation of mutually beneficial interactions. Animals convert oxygen into carbon dioxide while the plants do the opposite. In so doing, animals and plants help each other. Certain birds eat the food debris between the teeth of alligators. The alligators get their teeth cleaned, and the bird gets protection against potential predators. These are mutually beneficial, positive-sum relations.

We are beginning to see some clever, positive-sum use of industry in relation to the environment. The cooling system of some electric power generating facilities in Southern Illinois discharge heated water into lakes. This was previously called "thermal pollution". However, now the heated lakes are used for fish farming. But even if people do not deliberately farm fish, there will be more active fish community in such

lakes. In Europe, some factories discharge carbon dioxide. This would be air pollution if the discharge is released into the atmosphere. But the discharge is channeled into greenhouses to make the vegetables grow faster.

Not all industrial discharges can be used directly for biologically positive applications. But we can invent many ways to combine industries and environment in positive-sum relations.

Change of physical features of the environment due to industrial activities can also be beneficial to the ecosystem instead of being harmful. For example, the undulated landscape created by strip-mining of coal in Southern Illinois provides more enriched ecological environment than the otherwise flat land. Deep furrows become ponds, which not only provide habitats for animals and plants but also increase water retention capacity of the land and flood control. The cliffs which flank the deep furrows allow animals and birds to build burrows and nests. On gentler slopes, new species of plants can prosper. More importantly, the mix of many types of ecological niches --- ponds, cliffs and slopes --- within a small area generates interactions between species and enriches the ecosystem.

Furthermore, studies comparing the abandoned mine sites with and without subsequent leveling treatment indicate that the revegetating trees can grow their roots better in the untreated ground than in the treated ground. The leveling treatment by tractors produce a stratum of artificial top layer, and the roots tend to spread sideways at

the bottom of this stratum instead of penetrating deeper down. In many abandoned mine sites, the revegetation is more efficient if the sites are left without the cosmetic treatment to make them superficially look like the way they were before the mining. In such cases, it is illogical to require the land to be "restored" to the previous shape.

The view that any growth of industry necessarily means environmental deterioration is dogmatic, unscientific and unecological.

2. Heterogenistic thinking

Until recently, homogeneity was considered to be more basic and indispensable than heterogeneity. In the European and white American reasoning, heterogeneity was considered to be sources of conflict while homogeneity was believed to foster peace. Heterogeneity was regarded as bothersome, accidental, deviant, abnormal, undesirable, inconvenient or mere statistical distribution around the average with no advantage.

On the other hand, from the science point of view, the basic principle of biological, social and even some physical processes is increase of heterogenization, formation of mutually beneficial interactions, and pattern-generating. Heterogeneity is desirable and indispensable. It is the basis of biological, social and some physical systems.

The formulation of heterogenistic social theories is found in "The Second Cybernetics" (Maruyama 1963), "Heterogenistics" (Maruyama 1977) and "Morphogenetics" (Maruyama 1978). It is interesting to note that the philosophy of the Mandenka in West Africa (Camara 1975) was based on heterogenistic and morphogenetic principles long before the Western science "discovered" these principles to be "scientific".

We need a new frame of mind. But in attempting to do something new, we have a tendency to fall into the same pitfalls as the old way. Therefore it is necessary for us to examine at this point various ways to conceptualize heterogeneity.

Different frames of mind can be called "mindscapes" (Maruyama 1980). Mindscapes are perceptual/cognitive/cogitative patterns which may vary from individual to individual. There can be as many different mindscapes as there are individuals. But for practical purposes, I find it useful to distinguish four main types, abbreviated as H,I,S and G.

H: homogenistic, hierarchical, classificational
I: heterogenistic, independent, random
S: heterogenistic, interactive, homeostatic
G: heterogenistic, interactive, morphogenetic

Some of their characteristics are summarized elsewhere (Maruyama 1980).

There are many other types, and there are subtypes within each type. Mixtures can be formed between the types.

In any culture, it is possible to find individuals of all different types. However, the percentage distribution of different types may vary from culture to culture.

The H-type mindscapes tend to see the society or the universe in terms of similarities and general rules among its elements. They regard homogeneity as basic and normal, and consider heterogeneity as accidents, errors, abnormalities, deviances or mere statistical fluctuations. Another

aspect of the H-type mindscapes is the zero-sum game assumption: Since all persons need the same things, one person's gain is another's loss.

The I-type mindscapes occur usually as a rebellion against the H-type. They are individualistic, isolationistic and supportive of randomness. They see, or would like to see, society as an aggregate of independent individuals, each pursuing his/her activities unrelated to others', and doing his or her "own thing". Isolation and self-sufficiency are desirable, and interactions are seen as a negative-sum game: mutual loss will result from interaction.

S and G types see society as consisting of neterogeneous elements interacting for mutual benefit. Their concept of society is characterized by cause-effect loops (many things causing one another) and positive-sum game assumption. In the S-type, the interactions take place in such a way as to maintain a pattern among the heterogeneous elements. On the other hand the G-type interactions increase heterogeneity and positive-sum relations.

Neither the H-type mindscapes nor the I-type mindscapes recognize or use causal loops in their thinking, or allow for positive-sum relations. Therefore S and G types are NOT an intermediate position between H and I. They constitute different dimensions. Metaphorically, H and I are two sides of the same coin. S and G are two sides of a different coin. It must be emphasized that these two coins do NOT lie side by side on the same surface, NOR are parallel to each other. On the contrary, they are perpenticular to each other (Maruyama 1979b).

There are various subtypes within S and G. For example in S, there are equilibrists and cyclists. The former see social and economic processes

to gradually settle into an equilibrium. The latter see them to run in cycles. Both are variations within the same homeostatic mindscapes. On the other hand within the G-type, there are generative models, degenerative models and many other.

The advantages of heterogeneity between species within an ecosystem has long been appreciated. The richness of life in a tropical rain forest or on a coral reef is due to heterogeneity of species. If all animals ate the same food, there would be a food shortage, and if not all species are ~~not~~ eaten by some other species, there would be intolerable accumulation of corpses. Even solar energy is used maximally if different organisms use different methods to absorbe it: tall trees, short trees, vines, algae.

It is a mistake to consider the advantages of heterogeneity only in terms of resource diversification and disaster risk dispersion, as is done too often. The argument for resource diversification is often based on the zero-sum game assumption of H-type mindscapes, and the concept of disaster risk dispersion is rooted in the I-type thinking. Both are true and valid, but both overlook another advantage: the advantage of mutually beneficial positive-sum interactions, as we have seen in the example of birds who eat the food debris between the teeth of alligators.

It is important to recognize the mindscape basis of arguments, ideologies and theories. The same argument or ideology may stem from very different mindscapes, and the seeming agreement on the surface may stand on undetected mindscape differences. On the other hand, many apparently different theories and ideologies may be based on one common mindscape

and share the same fallacies. For example take the slogan "Small is beautiful" or "decentralization". H-type people can advocate it on the assumption that the whole country is homogeneous and nothing is lost by dividing the country into small parts. I-type mindscapes can also support the slogan because they see each community as different, unrelated to others, independent and self-sufficient. S and G thinkers can endorse it because they see the communities as heterogeneous and interacting for mutual benefit. It makes sense for heterogeneous communities to be administered separately, with the assumption that they interact non-hierarchically.

Similarly, "democracy" can be advocated by different mindscape types. There are even subtypes of democracy within one mindscape type. For example within the H-type, there are majority rule democracy and consensus democracy. Majority rule is nothing more than domination by quantity, though often implicit and unintentional rather than explicit. But the celebrated statement "the greatest amount of happiness for the greatest number of people" is explicitly quantitative. The alternative <u>within</u> the H-type is consensus democracy, which assumes the necessity and desirability of unanimity, often at the cost of coerced and self-coerced unanimity. On the other hand for the I-type, democracy means freedom from interference. But the I-type thinking also contributed to the concept of majority rule by encouraging each person to vote for his/her own interest regardless of others. The white American notion of democracy is a result of a mixture of H-type and I-type ways of thinking: majority rule, individual freedom, self-sufficiency and independence. When a person has voted for

his/her own interest, statistical tabulation will take care of the rest and legitimizes the person as being democratic.

S-type and G-type mindscapes produce notions of democracy very different from these. Let us take Navajos and Mandenka as examples. Navajos use a decision-making process quite different from majority rule or white Americans' notion fo consensus. Suppose a community must decide whether to build a bridge. In the majority rule system, votes will be counted, the decision is implemented and the matter has been "democratically" settled. On the other hand, Navajos will focus on the following consideration. If the bridge is built, some persons may suffer. If the bridge is not built, some other persons suffer. Either way, some people suffer. The important point is to give compensations to those who suffer, regardless of which way the decision goes. This is quite different from the majority rule system. But it is also different from the white American notion of consensus. The main goal of the consensus democracy is to give legitimation to the decision by obtaining unanimous agreement, rather than to give compensations to those who would suffer from the decision. But I may add that there are some white American communities which used Navajo-like methods. The city of Portland, Oregon has once contemplated a downtown plan to close every other street to vehicle traffic and convert it to a pedestrian mall. The problem was to choose which streets to close. Stores facing pedestrial malls would have certain advantages as well as disadvantages compared to stores facing vehicle streets. No matter which streets were chosen, some would benefit and some would suffer. A solution was to modify tax structures to compensate for the differences.

Both the government and the consumer groups or environmentalist groups have a strong tendency to try to impose standardized "environmental regulations" uniformly, unscientifically and dogmatically in varied situations in different localities. This is often done with a mistaken notion that to be scientific is to be uniform. Such a notion is quite unscientific.

We must assess the level and type of hazard in geographic, climatic, social, cultural and other contexts. The requirement to have sewage-connected toilet may be "environmental" in some areas, but not in areas where the overloaded sewage system discharges untreated sewage into river, such as in the eastern suburbs of Portland, Oregon. Similarly, in arid regions, open-air toilet without cover is more sanitary than covered tanked toilet. And garbages in permanently frozen regions do not rot, but gradually get dehydrated while frozen. We must have environmental regulations, but these regulations must not be applied blindly. In fact, we need to establish requirements that the environmental regulations should be <u>contextual</u>. It must be emphasized that this concept is different from regionalization of environmental regulations. Regionalization per se does not assure contextual application of regulations. In fact, it may as well end up with dogmatic and unscientific applications.

Let us also add that it is not necessarily regulations per se, but <u>unpredictable changes</u> in regulations that affect the business more adversely. The uncertainties which affect business are often quite different from what non-business sectors assume them to be. They come less from depletion of natural resources and energy which is predictable, but more from <u>fluctuations of consumer behavior</u> and <u>changes</u> in government regulations. Business and industries which must make long-range planning and

investment are paralyzed by such unpredictable changes or by mere fear of such changes.

3. The fallacies of equilibrium theories and static view of ecosystem.

The view that equilibrium is both natural and desirable has been popular in many fields of physical, biological and social sciences. But they have become replaced by other theories in many of the fields. A crucial conceptual restructuring occurred in early 1960s (Maruyama 1963) but its forerunners date back a few decated earlier in some fields, while in a few other fields it has not yet begun to be appreciated.

All these developments make us realize that the assumption of equilibrium to be both natural and desirable is quite inadequate. Obviously the economic theory of equilibrium does not work in our present situation. Equally deficient are the equilibristic notions in management science and environmental movements. For example, many of the environmentalists mistakenly advocate that the nature must stay the same. This is unscientific and dogmatic. The nature keeps changing and evolving, even without humans. To force the environment to stay unchanged is to impose an artificial misconception against the nature.

4. Disproportional amplification in causal loops.

Causal loop systems behave in ways quite different from non-loop systems. Homeostatic loops make the system converge to similar states or cycles, while pattern-generating loops develop the system into quite divergent

states beginning from similar initial conditions. This is quite contrary to the common-sense notion that similar conditions produce similar results and different results must be accounted for by correspondingly different conditions.

For action-oriented persons, an important concern is how to build desirable causal loops and break undesirable ones, as well as how and where to give an initial kick once a desirable loop has been built.

5. Goal Moratorium Syndrome

We mentioned that our society is currently suffering from a goal moratorium syndrome (Maruyama 1979a) resulting from mutual amplification of goallessness between business, government and consumer sector. Let us now discuss some details of this mutual amplification, and examine ways to break this mutual amplification, and give a kick for mutual amplification of goals.

We have said that business sector's uncertainties stem less from eventual depletion of natural resources and energy, but more from fluctuations of consumers' purchase patterns as well as unpredictable changes in government regulations and policies. These fluctuations and unpredictable changes disable the business to plan, invest and produce. Therefore the goallessness in the consumer or in the government prevents business from setting goals. On the other hand, the consumers' goallessness in their purchasing patterns is a result of fear of unemployment or other types of income decrease, actual unemployment, underemployment and misemployment, and inflation, which reflect the decline and goallessness of the business sector. The

government's lack of goals have two main sources: (i) declining business and resulting loss of national prestige and political leverage; (ii) public pressure for more regulation against business and industry, and less regulation in some other areas, less tax and more service. In other words, the government's goallessness is aggravated by the goallessness in the business sector, and by the public's anti-business, anti-government attitude. Where and how can we break this vicious circle?

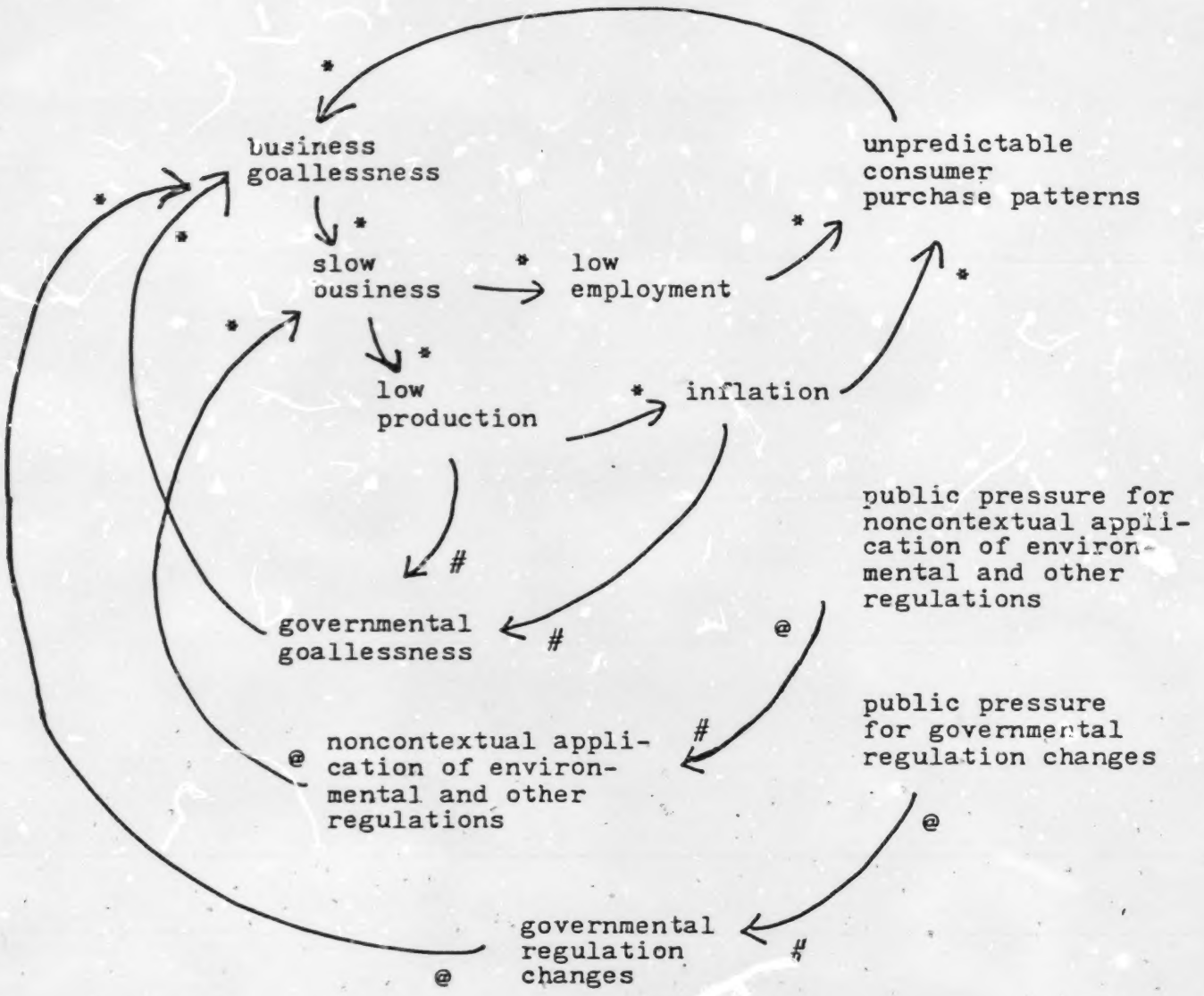
We have seen that the hidden economic, psychological and institutional costs of the goal moratorium syndrome are far greater than what can be seen in statistics. How can we break this vicious circle of amplification of goallessness? Let us first summarize the components of the causal loop:

(a) The business sector's goallessness and slowdown are caused by:
  i. unpredictable consumer purchase patterns.
  ii non-contextual application of environmental and other regulations.
  iii. unpredictability of governmental regulation changes.

(b) The consumers' goallessness is caused by:
  i. unemployment or fear of unemployment.
  ii. inflation or fear of acceleration of inflation.

(c) The government's goallessness is caused by:
  i. economic decline of U.S.A.
  ii. public pressure to change regulations: more against business and industry, less taxes, more governmental services.

We can make the following diagram of the causal relations (next page):



Arrows show the direction of influence.

@ indicates that the influence can be halted by the element giving it.

# indicates that the influence can be resisted by the element which receives it.

* indicates that the influence cannot be resisted by the element which receives it.

There are two types of elements in this diagram: (i) elements which are in loops; (ii) elements which are not in loops.

Some of the elements are strong leverage points. A strong leverage point may be defined as an element which receives few or no *-type influences or gives many or some @-type influences.

Elements which do not receive influences from other elements are obviously good leverage points. Under this category, we have two elements "public pressure for noncontextual application of environmental and other regulations"; and "public pressure for governmental regulation changes". As we have seen, these stem from the attitudes and philosophies of the public, such as the zero-sum game assumption and the equilibrium assumption. Therefore the primary cure of the goal moratorium syndrome consists in changing the fallacious assumptions and philosophies held by the public.

The secondary cure consists in working on other strong leverage points in the loops. Elements at these points are in a position to resist influences from other elements or to restrain their own influences on others, even though it will take some efforts to do so. There are three strong leverage points in the diagram: "governmental goallessness"; "noncontextual application of environmental and other regulations"; and "governmental regulation changes". The third is the easiest to explain. If we use this leverage point, our policy is "Do not change government regulations unpredictably". The use of the second leverage point can be implemented by establishing a requirement for <u>contextual</u> application of regulations. Let us emphasize that this is different from deregulation. It is also different from decentralization. Decentralization may as well end up with non-contextual application of another kind.

The use of the first leverage point needs some elaboration. It means that the government must generate goals. This is neither impossible nor paradoxical if we learn some leasons from history. In the ruins of the Second World War, Japan established its Ministry for International Trade and Industry and provided the priority industries with long-term loans from the Japan Development Bank, enabling them to plan for long-range gains, unlike the American firms which are under pressure to show quarterly profits to their stockholders. This was done under economic conditions worse than those in the U.S.A. today. For food, an average person often had only one or two bowls of very diluted cereal soup a day and notheng else. The infrequent commuting trains were so packed with people that the human body pressures often cracked the doors open, spilling out passengers while the trains were running at full speed. The public did not mind it much because life seemed harder than death. Weekend trains were filled with people going to buy black market potatoes on farms. Once a train derailed and killed many passengers, and the survivors looted the dead and the dying for money and for potatoes. One mother killed a child to feed his meat to other children. She received sympathy instead of punishment. I myself suffered from occasional mental blackouts and physical seizures from malnutrition. Inspite of, or rather because of, such economic conditions, the Japanese government generated long-range goals.

What are some specific goals the U.S.Government can generate? Even

though the American government is reputed for its inability to make long-range planning, it has some positive records. The frequently cited Apollo Project was an example.

We can also find examples in the private sector. One was the Mayflower voyage of the immigrants. It required tremendous investment and financing (Dyson 1970). Another was the Mormon's exodus from the East Coast to Utah. Mormons kept meticulous financial records, from which we learn that the costs were fairly comparable, in converted equivalent values, to our emigration to an asteroid (Dyson 1979). One may argue that the Mayflower voyage and the Mormon exodus could find financing because the former was ideological and the latter was religious, and neither was designed for economic profit, and that we cannot do anything similar using taxpayers' money. But the Apollo Project was political, not economic

What would be some goals we can generate? Orville Freeman (1980) talks about a new kind of world economic system: now some countries are rich in material resources but poor in technology and management skills; others are rich in money and energy but poor in industrial capacity; Some have science, technology and management skills but have little money. A solution is to combine these various assets cross-nationally. In fact, many business firms already practice such combinations. But in the governmental sector, the nations are still playing the zero-sum game. A shift to positive-sum game between the governments is a necessity. Freeman optimistically says that it will be done because there is no other alternative. But he admits that it will be a difficult task and we will have a terrible time ahead until we succeed in it.

Let us not forget the fact that no matter how much the governments cooperate with one another, we will eventually run out of energy from oil, coal and natural gas. Saudi Arabia is already planning 25 to 50 years ahead for the time when its petrolium reserves will be depleted or the need for petrolium will decrease due to development of alternative energy sources. Saudi Arabia is investing heavily in solar energy research in order to make use of its arid, tropical land.

Much solar energy can be collected on earth. But sooner or later we have to collect solar energy in outer space, both for use on earth and for running industries and communities in outer space. Technological and economic feasibility of such projects has been established (NASA 1976; AIAA 1975,1977,1979). The first outer space community may be small or large. A fairly large one for 10,000 inhabitants will cost less than all the Apollo projects combined. Subsequent communities will cost less to build, using the preceding communities as a base. Life in such a community will be more comfortable than the life on earth in many respects (Maruyama 1976). Compared to it, Earth may be regarded as a place which contains uncontrolled weather and harsh climate for those who love physical adventure, a historical museum, a biological preserve or a primaeval place for tourism. The question is no longer whether we should move onto outer space, but when. The answer is that the sooner, the less suffering we have to endure meanwhile. But if we wish, we can postpone this project for perhaps a decade. What is important is to have a vista, not necessarily of the outer space living but of something comparable in scope. Such a vista generates goals.

The goals must have enough specificity in order for the business sector to move ahead. For example, if the outer space solar energy

project is to be initiated by the business sector, it requires a multi-business venture: many types of business must get together to work out the details to assure smooth supply-demand flow and parallel flow of co-need products (similar to ski shoe / ski relation). They cannot wait for each other to get ready: that would lead to mutual amplification of waiting. If the project is to be initiated by the government using business infrastructures as contractors and subcontractors, the government must clearly spell out the extent and the nature of the business sector participation for a long-term period of two or three decades. Ambiguities and long-term uncertainties surpress and delay the business sector preparation and willingness to participate.

Conclusion

The environmentalist movement of the future must free itself from the fallacious assumptions of zero-sum game, static environment and homogeneous noncontextual application of regulations, and make the environment/people/business/government relations positive-sum, heterogenistically interactive and morphogenetic.

(references next page)

References

American Institute of Aeronautics and Astronautics. 1975,1977,1979. Proceedings of Princeton Conferences on Space Manufacturing Facilities.

Camara, Sory. 1975. The Concept of Heterogeneity and Change among the Mandenka. Technological Forecasting and Social Change 7:273-284.

Dyson, Freeman. 1979. DISTURBING THE UNIVERSE. New York:Harper & Row.

Freeman, Orville. 1980. Lecture given at the World Future Society Global Conference, Toronto, July 1980.

Maruyama, Magoroh. 1963. The Second Cybernetics: Deviation-amplifying Mutual Causal Processes. American Scientist 51:164-179;250-256.

Maruyama, Magoroh. 1976. Designing a Space Community. Futurist :273-281.

Maruyama, Magoroh. 1977. Heterogenistics: an Epistemological Restructuring of Biological and Social Sciences. Acta Biotheoretica 26:120-136.

Maruyama, Magoroh. 1978. Heterogenistics and Morphogenetics: Toward a New Concept of the Scientific. Theory and Society 5:75-96.

Maruyama, Magoroh. 1979a. Goal Moratorium Syndrome. Technological Forecasting and Social Change 15:1-9.

Maruyama, Magoroh. 1979b. Mindscapes:Limits to Thought. World Future Society Bulletin 13:13-23.

Maruyama, Magoroh. 1980. Mindscapes and Science Theories. Current Anthropology 21:589-608.

National Aeronautics and Space Administration. 1976. SPACE SETTLEMENTS: A DESIGN STUDY. SP-413.